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GAS *v.* ELECTRIC LIGHTING.

THE most important practical scientific question of the hour, and the one of greatest public interest, is that of illumination by means of electricity. Every day the subject is developing and attracting more and more attention. As we predicted long ago, the Paris Exposition, and the fine display of the power and beauty of the electric arc which has been this year made patent to all the world in that city, have given an incalculable impetus to the progress of this mode of lighting. It has been said, doubtless by some timid holder of gas shares with whom the wish was father to the thought, that with the Paris Exhibition so would the electric light pass away again, and sink into the darkness from whence it sprung; but there is now no fear of that. It has made too great an impression on the public mind, and gained too widespread a footing for itself in practical usage now, to lapse into obscurity. Inventors, too, are giving their ingenuity to the solution of the difficulties which still bar its advancement, a great many patents relating to it are being taken out in all civilised countries, it is one of the present tides in the affairs of men which may lead to fortune—in short "there is money in it," and its ultimate success is undoubted.

It has hitherto been the habit of gas investors to dread, and of gas directors to repudiate, the electric light as a promising rival of gas. It would seem indeed as if colour blindness was unusually common amongst the directors of gas companies, for few of these gentlemen have been able to see the superior excellence of the electric light over gaslight. To them it has appeared a weird ghastly glow, reminding them of corpse-lights and mortal decay. If it be true that gas directors are particularly subject to jaundiced vision, a philosophic oculist might, with some show of reason, attribute the fact to the meretricious influence of the yellow gaslight they have been so long habituated to. From recent meetings, however, we are happy to see that a change has taken place in the attitude of the leading London gas companies towards the new illuminator. It is no longer pooh-poohed by them, but wisely regarded as a declared rival, which must be fairly competed against if gas-lighting is to hold its ground. The cost of electric lighting for street purposes is at present so much more than gas that, although the superiority of the light is unquestionable, there will be no hurry to supersede gas by it. But even if all the streets of the metropolis were lit by electricity, we are told that it would only cause a reduction of about 1 per cent. on the gross revenues of the companies who get their principal receipts from domestic lighting. If this be so, there is no immediate cause for a panic among gas shares, and gas shareholders may use the statement as a prop to their tottering faith. But we would advise them not to trust too implicitly to consolation of this kind.

It is true that at present an invention, by which the electric current supplying the electric lamps can be subdivided so as to feed a great many light centres, and thus at the same time moderate while it distributes the light, is a desideratum necessary to the complete success of electric lighting even for general street purposes, let alone household uses. But tried inventors are at work on the problem, and any day may see its accomplishment. Some comfort may be derived from reflections that gas lighting will never be driven from the field, that gas will be more and more used for heating purposes, that it will even be used in gas engines for generating powerful electric lights, and that at least for many years to come it will keep its impregnable position as a domestic illuminator. But at the same time it should not be forgotten that an invention may come any day which will dispel these dreams of security, and banish gas lighting to a secondary place. In proof of this we have only to cite the report from America (published on another page) that the indefatigable Mr. Edison has succeeded in solving the problem of general electric illumination in the most thorough and sweeping manner. While the gas companies were in the act of laying the soothing unction to their souls, and congratulating themselves on their safe position even against electric street lighting, the news was being flashed across the Atlantic that Edison had invented a means of subdividing the electric current indefinitely, so as to produce 1,000 lights if need be from one machine, and of bringing it into homes for household purposes, such as lighting, heating, and driving sewing machines, at half the cost of gas and without disturbing the existing brackets and chandeliers.

The Napoleon of invention delights in startling surprises, and his fertile and daring imagination runs at once through the whole gamut of possibilities as soon as the key-note of a new idea is struck. Future developments are to him as if they already existed; but for all that the great mechanical genius of Mr. Edison is so well attested, that any report of the kind is to be taken seriously. It is a sign of the uncanny reputation of this inventor, that on the publication of the said announcement in London on

October 8th, the gas shares fell seven per cent. No opinion can be passed on the merits of the new invention until a description of it is made public, which will not be until the patents are secured. Meanwhile, both inventors, gas shareholders, and the general public will be interested to learn what the coming disclosure is to be. We trust that Mr. Edison, for his own as well as others sake, has made himself certain of the success of his invention before sending forth the telegrams proclaiming it. It is a fine thing, no doubt, to assume the god and shake the spheres with a nod; but it must not be forgotten that the disturbance may cost heavily to humbler beings. In conclusion, we would remark that the announcement that the problem of dividing the light has been completely solved by Mr. Edison need not deter other inventors from giving their minds to this matter. We have yet to learn what the new system is, and although Mr. Edison is admittedly a great inventor, he cannot be supposed to monopolise all ideas on the subject, nor even always to hit upon the best.

EDISON'S ELECTRIC LIGHT.

INFORMATION reached this country on Monday, October 7, stating that Mr. Edison, the inventor of the phonograph, had succeeded in dividing the electric light, so as to apply it to the existing gas fixtures, at a considerable reduction in cost. The same communication was made to the American Commissioners at the Paris Exhibition, and through them made known in London. On the news of this discovery becoming known, a heavy fall in the value of gas shares took place. The following description of Mr. Edison's invention is taken from the *New York Sun*:—

"Mr. Edison says that he has discovered how to make electricity a cheap and practicable substitute for illuminating gas. Many scientific men have worked assiduously in that direction, but with little success. A powerful electric light was the result of these experiments, but the problem of its division into many small lights was a puzzler. Gramme, Siemens, Brush, Wallace, and others produced at most ten lights from a single machine, but a single one of them was found to be impracticable for lighting aught save large foundries, mills, and workshops. It has been reserved for Mr. Edison to solve the difficult problem desired. This, he says, he has done within a few days. His experience with the telephone, however, has taught him to be cautious, and he is exerting himself to protect the new scientific marvel, which, he says, will make the use of gas for illumination a thing of the past. While on a visit to William Wallace, the electrical machine manufacturer in Ansonia, Connecticut, he was shown the lately perfected dynamo-electric machine for transmitting power by electricity. When power is applied to this machine it will not only reproduce it, but will turn it into light. Although said by Edison to be more powerful than any other machine of the kind known, it will divide the light of the electricity produced into but ten separate lights. These being equal in power to 4,000 candles, their impracticability for general purposes is apparent. Each of these lights is in a substantial metal frame, capable of holding in a horizontal position two carbon plates, each 12in. long, 2½in. wide, and ½in. thick. The upper and lower parts of the frame are insulated from each other, and one of the conducting wires is connected with each carbon. In the centre, and above the upper carbon, is an electro-magnet in the circuit, with an armature, by means of which the upper carbon is separated from the lower as far as desired. Wires from the source of electricity are placed in the binding posts. The carbons being together, the circuit is closed, the electro-magnet acts, raising and lowering the upper carbon enough to give a bright light. The light moves towards the opposite end from which it starts, then changes and goes back, always moving towards the place where the carbons are nearest together. If from any cause the light goes out the circuit is broken, and the electric magnet ceases to act. Instantly the upper magnet falls, the circuit is closed, it relights, and separates the carbon again. Edison on returning home after his visit to Ansonia studied and experimented with electric lights. On Friday, October 4, his efforts were crowned with success, and the project that has filled the minds of many scientific men for years was developed. 'I have it now!' he said, on Saturday, while vigorously turning the handle of a Ritchie inductive coil in his laboratory at Menlo Park, 'and, singularly enough, I have obtained it through an entirely different process than that from which scientific men have ever sought to secure it. They have all been working in the same groove, and when it is known how I have accomplished my object, everybody will wonder why they have never thought of it, it is so simple. When ten lights have been produced by a single electric machine, it has been thought to be a great triumph of scientific skill. With the process I have just discovered I can produce 1,000—aye, 10,000—from one machine. Indeed, the number may be said to be infinite. When the brilliancy and cheapness of the lights are made known to the public—which will be in a few weeks, or just as soon as I can thoroughly protect the process—illumination by carburetted hydrogen gas will be discarded. With 15 or 20 of these dynamo-electric machines recently perfected by Mr. Wallace I can light the entire lower part of New York city, using a 500-horse power engine. I purpose to establish one of these light centres in Nassau Street, whence wires can be run up town as far as the Cooper Institute, down to the battery, and across to both rivers. These wires must be insulated, and laid in the ground in the same manner as gas pipes. I also propose to utilise the gas burners and chandeliers now in use. In each house I can place a light meter, whence these wires will pass through the house, tapping small metallic contrivances that may be placed over each burner. Then housekeepers may turn off their gas and send the meters back to the companies from whence they came. Whenever it is desired to light a jet it will only be necessary to touch a little spring near it. No matches are required.' 'Again, the same wire that brings the light to you,' Mr. Edison continued, 'will also bring power and heat. With the power you can run an elevator, a sewing machine, or any other mechanical contrivance that requires a motor, and by means of the heat you may cook your food. To utilise the heat it will only be necessary to have the ovens or stoves properly arranged for its re-

ception. This can be done at trifling cost. The dynamo-electric machine, called a telemachon, and which has already been described, may be run by water or steam power at a distance. When used in a large city the machine would of necessity be run by steam power. I have computed the relative cost of the light, power, and heat generated by the electricity transmitted to the telemachon to be but a fraction of the cost where obtained in the ordinary way. By a battery or steam-power it is 46 times cheaper, and by water-power probably 95 per cent. cheaper.' It has been computed that by Edison's process the same amount of light that is given by 1,000 cubic feet of the carburetted hydrogen gas now used in this way, and for which from 2 dollars 50 cents to 3 dollars is paid, may be obtained for from 12 to 15 cents. Edison will soon give a public exhibition of his new invention."

THE ELECTRIC LIGHT IN SHOPS.

THE first instance of the application of the electric light to the illumination of a retail business establishment in the metropolis took place last evening on the premises of the London Stereoscopic Company, in Regent Street. Having made use of the electric light for photographic purposes, the Company thought they might as well avail themselves of electric power as a source of light instead of gas. In the basement of the building is an Otto silent gas engine, capable of working up to eight horse-power. In order to generate the electric light the engine is worked up to a power of five horses, the outlay for which is reckoned at 5d. per hour. This engine drives a shaft at the rate of 750 revolutions per minute, working one of Siemens' dynamo-electric machines, from whence the current is conveyed to a lamp suspended from the facia over the shop front, the lamp being fitted with one of Siemens' automatic regulators, a magnet being brought into play to keep the carbon points at the requisite distance from each other. The cost of maintaining the light, including the 5d. per hour for the five horse-power of the gas engine, is stated to be 7d. per hour. The light is reckoned as equal to 4,000 sperm candles. The lamp takes the place of ten powerful argand burners previously used to illuminate the shop front, which is of considerable length as well as height. As may be supposed, the electric light far exceeds in volume and intensity the amount of illumination obtained from the ten argand gas burners. The trial last night was to some extent experimental, and there was considerable unsteadiness in the light—a circumstance attributed to the wind which blew at the time, the interior of the lamp being imperfectly protected from the blast. The lamp was globular in form, with ground glass for the transparent medium. The effect of the light was very good, the coloured photographs in the window exhibiting their proper colours as in daylight. There was nothing either ghastly or ghostly in the appearance of the passers by as they traversed the flood of radiance which fell on the footway. But the gaslights decidedly suffered, and presented a dismal appearance, the street beyond the range of the electric rays looking as if plunged in some unusual gloom. The general effect differed somewhat from that which is observable at the Gaiety Theatre, where the Lontin light is exhibited, the light in Regent Street being whiter, with a tinge of violet. Some difference in the transparent medium is perhaps the cause, or it may be that the Siemens' light is stronger than the Lontin. The Siemens' lamp requires a renewal of the carbons at the end of three hours, but that extent of duration is sufficient for an establishment which adopts the early closing principle. Fresh carbons can be inserted in about three minutes, or less. If a second lamp be provided the current can be diverted from one point to the other in a couple of seconds. It will be observed that in this case there is no division of lights, the whole of the current flowing to one lamp. With some little adjustment the light promises to answer well, and the experiment of last night was held to be amply satisfactory.—*Standard*, Oct. 9.

A NEW SYSTEM OF ELECTRIC LIGHTING.

By Profs. ELIHU THOMSON and EDWIN J. HOUSTON, of the Philadelphia Central High School.

HAVING been engaged in an extended series of experimental researches on dynamo-electric machines and their application to electric lighting, our attention has been directed to the production of a system that will permit of the use of a feebler current for obtaining an electric light than that generally employed, or in other words, of using, when so required, a current of insufficient intensity to produce a continuous arc. At the same time our system permits of the use of a powerful current in such a manner as to admit of a considerable number of electric lamps being placed in the same circuit.

As is well known, when an electrical current, which flows through a conductor of considerable length, is suddenly broken, a bright flash, called the extra spark, appears at the point of separation. The extra spark will appear although the current is not sufficient to sustain an arc of any appreciable length at the point of separation.

In our system, one or both of the electrodes, which may be the ordinary carbon electrodes, are caused to vibrate to and from each other. The electrodes are placed at such a distance apart that in their motion towards each other they touch and afterwards recede a distance apart, which can be regulated. These motions or vibrations are made to follow one another at such a rate, that the effect of the light produced is continuous; for, as is well known, when flashes of light follow one another at a rate greater than twenty-five to thirty per second, the effect produced is that of a continuous light. The vibratory motions may be communicated to the electrodes by any suitable device, such for example as mechanism operated by a coiled spring, a weight, compressed air, &c., &c., but it is evident that the current itself furnishes the most direct method of obtaining such motion, as by the use of an automatic vibrator, or an electric engine.

In practice, instead of vibrating both electrodes, we have found it necessary to give motion to but one, and since the negative electrode may be made of such size as to waste very slowly, motion is imparted to it, in preference to the positive. The carbon electrodes may be replaced by those of various substances of sufficient conducting power.

In this system, when desired, an independent battery circuit is employed to control the extinction and lighting of each lamp.

The following is a description of one of the forms of electric lamp which we have devised to be used in connection with our system of electric lighting.

A flexible bar B, of metal, is firmly attached at one of its ends to a pillar P, and bears at its other end an iron armature A, placed opposite the adjustable

FIG. 1.

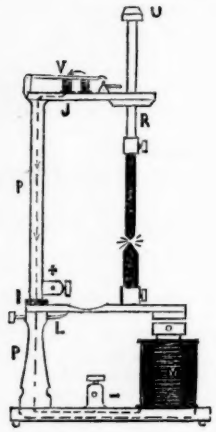


FIG. 2.

pole piece of the electro-magnet M. A metal collar C, supports the negative electrode, the positive electrode being supported by an arm J, attached to the pillar P. The pillar P is divided by insulation at I into two sections, the upper one of which conveys the current from the binding screw marked + to the arm J, and the rod R, supporting the positive electrode. The magnet M, is placed, as shown by the dotted lines, in the circuit which produces the light. The pillar P is hollow, and has a insulated conducting wire enclosed which connects the circuit closer V with the binding post. The current is conveyed to the negative electrode through B and the coils of the magnet M.

When the electrodes are in contact, the current circulating through M, renders it magnetic, and attracts the armature A, thus separating the electrodes, when by the consequent weakening of the current the elasticity of the rod B again restores the contact. During the movement of the negative electrode, since it is caused to occur many times per second, the positive electrode though partially free to fall, cannot follow the rapid motions of the negative electrode, and therefore does not rest in permanent contact with it.

The slow fall of the positive electrode may be ensured either by properly proportioning its weight or by partly counterpoising it. The positive electrode thus becomes self-feeding.

The rapidity of movement of the negative carbon may be controlled by means of the rigid bar L, which acts partially to shorten or lengthen the part vibrating.

In order to obtain an excellent but free contact of the arm J, with the rod R, bearing the positive carbon, the rod, made of iron or other suitable metal, passes through a cavity S, fig. 2, filled with mercury, and placed in electrical contact with the arm J. Since the mercury does not wet the metal rod R, or the sides of the opening through which it passes, free movement of the rod is allowed without any escape of the mercury. It is believed that this feature could be introduced advantageously into other forms of electric lamps.

In order to prevent a break in the circuit occurring when the electrodes are consumed, a button U, is attached to the upper extremity of the rod R, at such a distance that when the carbons are consumed as much as is deemed desirable, it comes into contact with a tripping lever T, which then allows two conducting plugs attached to the metal bar V to fall into their respective mercury cups, attached directly to the positive and negative binding posts respectively. This action serves practically to cut the lamp out of the circuit.

THE LATE WILLIAM HOOPER.

WILLIAM HOOPER died on the 25th September at Beechwood, Clapham Common, in his sixtieth year. During the last twenty years Mr. Hooper had occupied a position of some prominence in telegraphic science, and although our materials for putting this notice together are scant, we shall endeavour to lay before our readers a brief outline of his professional life.

To the telegraphic profession Mr. Hooper's name is well known as the inventor and manufacturer of an india-rubber insulated wire, and the founder of Hooper's Telegraph Works, Limited. We may however point out that as a pharmaceutical chemist he held a very high position, and contributed, in no small measure, to the improvement in manufacturing medicinal preparations from plants.

As an india-rubber manufacturer he was also well known, and especially as the inventor and manufacturer of water beds, &c., for invalids, which at one time were in use in over 1,000 hospitals and similar institutions.

Although we can scarcely regard him as a remarkable inventive genius, there is no doubt that his life presents to us a very satisfactory illustration of well directed energy.

In order to attain to the position which he gained in three such distinct branches of business, much mental ability must have been required, and the way in which this was directed, is as deserving of our admiration as if it had been turned towards purely scientific results.

Mr. Hooper was born at Dillon Barton, near Exeter, and was apprenticed to a chemist and druggist in that city. He opened a business at 7, Pall Mall East, London, as a pharmaceutical chemist, and a few years later opened a branch at 55, Grosvenor Street, and a laboratory in Scotland Yard. The space employed for this purpose being subsequently taken by the Electric Telegraph Company for a store or depôt, the laboratory was removed to Mitcham in Surrey.

At Mitcham he started with Mr. Fry in the manufacture of india-rubber goods, trading under the name of Hooper and Fry. On the retirement of Mr. Fry from the business it was carried on by Mr. Hooper until 1860-61, when the general business was dis-

continued to make room for carrying out the manufacture of his patent india-rubber wire under an arrangement with Messrs. R. S. Newall & Co., which, unfortunately, was cancelled by litigation between the parties. A few years later a partnership was entered into with Mr. (now Sir George) Elliott, and it was said that this arrangement on the part of Sir George Elliott was to induce the Gutta-Percha Company to combine with the firm of Glass and Elliott to form the present Telegraph Construction and Maintenance Company.

This was followed by a second arbitration, so that the first seven years of Mr. Hooper's patent flew past without the slightest benefit accruing. It is perhaps within the mark if we say that at least £25,000 was spent during these seven years to free Mr. Hooper's hands, and to allow of the working of his patents.

Not only did Mr. Hooper rely on his own individual resources for perfecting his patents and securing a trial of the merits of his core, but he succeeded in removing a very strong feeling of opposition which at one time seemed too influential to admit of being overcome by a private individual.

In the year 1865 several lengths of india-rubber insulated wires by different manufacturers were sent to India to test their durability and suitability for that climate. The only one which remained good was that made by Mr. Hooper. This led to his receiving several orders from the Indian Government, and established the reputation of his manufacture. We believe that about 12,000 miles of cable have been made with this core, the last of which, made and laid for the Cuba Submarine Telegraph Company in 1875, is a practical proof of its merits. Without exception it is, when well made, electrically, the most perfect cable in existence.

In the year 1870 Mr. Hooper's business as a contractor had increased so extensively that he formed a limited liability company, which was known as Hooper's Telegraph Works, Limited.

Little is known of what led to the collapse of this company, but at the time negotiations had been going on for making and laying a cable to the Cape, for which line Hooper's Company held the concession, &c., from the Government. We have heard that the manufacture of an Atlantic cable for the French company was also being negotiated for.

Mr. Hooper was a liberal supporter of science, and we have been informed that no invention bearing on submarine telegraphy which was submitted to him was dismissed without the most attentive study.

One very important matter which Mr. Hooper had worked upon was the protection of iron, &c., used in the covering of cables. In his earlier patents he proposed a covering of vulcanized rubber for this purpose. Attention is being again directed to this matter from the fact that two Atlantic cables are now defunct from the corrosion of the iron wires not allowing their being fished up.

It is a general opinion that Mr. Hooper largely profited by his company; this we believe is an error. If we consider that Mr. Hooper, in the first place, held over one-fourth of the total shares of the company, and that the latter was indebted to him for nearly £150,000. We can easily conceive that he would have been a great deal better off without the questionable extension of business which it is considered accrues from the conversion of a flourishing undertaking into a limited liability concern. Few men have perhaps worked harder for an object where such disappointing results have followed. It is not often that it is our pleasure to refer to a life more usefully spent; we should therefore have regretted to allow the moment to pass without adding our token of respect to the memory of the late William Hooper.

We fully believe that one very important benefit to submarine telegraphy, arose from his labours and those of other india-rubber manufacturers threatening the monopoly of gutta-percha as an insulator, which led to great improvements in gutta-percha cables.

VANDER PLOEG'S TYPE PRINTING TELEGRAPH APPARATUS.

THERE have perhaps been invented more varieties of type printing than of any other kind of telegraph instruments. Many of these differ from one another in but very unimportant details, and it is not often that any very distinct points of novelty are introduced. Mr. Ploeg's apparatus, however, decidedly possesses features which, as far as we know, are not found in any existing forms of printing instruments, and therefore it well deserves being brought to notice.

The apparatus consists essentially of a transmitter, a "speaker" and "reinforcer," and a receiving and printing apparatus.

The transmitter, fig. 1, is constructed with a handle 1, which in several revolutions imparts by means of a pinion 5, and wheels 3, 4, one revolution to an axis on which the needle 10 is fixed.

The handle has four optional points of rest, 6, 7, 8, 9, placed in horizontal and vertical lines, and in turning it forwards or backwards the needle 10 is turned in the same direction; the points 6, 7, 8, 9, correspond to the spaces on the dial around which the needle 10 turns.

The axis of the needle is attached and gives motion to a wheel 11, which makes or interrupts the contact in the line circuit at the points 12 and 13, and it carries by friction a bar 14, which is pushed against a stop 15 when the axis is turned from right to left, and which is pushed against a stop 16 when the axis is turned in the reverse direction. Whilst moving between 15 and 16, the bar causes an oscillation of a reverser or commutator 17, the two arms 18, 19, of which, separated from each other, sometimes put the part 20 in contact with 21, and 22 with 23, and sometimes 20 with 23, and 21 with 22. Thus the current of the battery, which enters the apparatus at 20, passes through it by the points of contact 12, 13, and leaves it at 21 to pass along the line and return by the earth at 23, will be reversed according to the direction in which the handle 1 is turned; it will be positive in the line on turning the handle from right to left, and negative on turning it from left to right, or *vice versa*, but always inversed in a contrary direction.

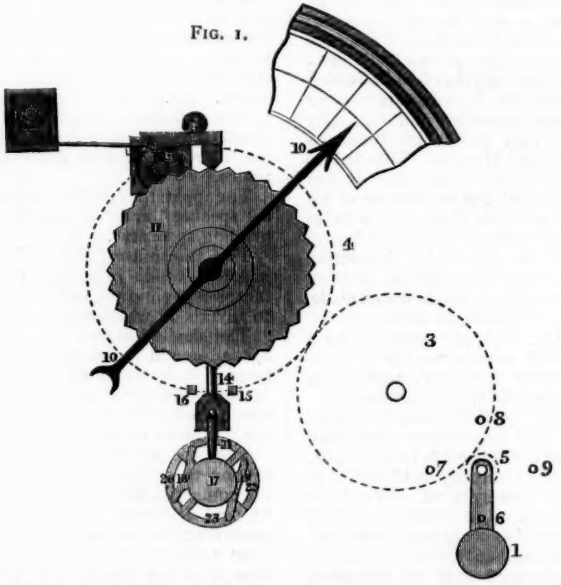
To clear the line at the point of departure of a possible overcharge of current, there is a small spring 24 which brings the line into contact with the earth between the reversals of the current.

The dial contains a double border divided into any required number of spaces for the characters required in telegraphy. For those in the outer border the handle is turned to one side, and for those in the inner border it is turned to the other side. At each character there is in the apparatus a contact, and at each passage from one character to another there is an interruption, and an inversion at each change of direction.

The speaker (so-called) and reinforcer is shown by fig. 6. When at rest, one of its arms 26 remains fixed against the point 25, and then allows the current of the batteries A and C to pass through 28 and 27 to the transmitter; the battery B is then not in action. When the finger-stud 31 is pushed down, the arm 26 retires from its point of contact 25; but before leaving it the opposite arm 32 touches its point of contact 33, and at that moment the points 25 and 33, are in communication, so that the poles of the battery B are closed, and the current passing through the sounder 34 attracts its armature, which thus makes a noise or sound. On continuing to push the rod 31 down to the bottom, the arm 26 is made to leave its point of contact 25, and thus there is a communication only between the points 27 and 33, and at this moment the battery B is connected to the batteries A and C, which now regularly enclose all the elements. In this position the line current which passes through the transmitter will be considerably increased; however, there is, between the depressing and releasing of the stud 31, an alternative as to the current of the line, that is to say, either there is a current in the line, or there is none; if there is a current it continues to pass through the sounder 34 (which is wound with thickish wire) and so keeps its armature attracted. On lifting the hand from the stud, the lever resumes its former position, and the armature of the sounder falls back; in this case only one sound is heard; if, on the contrary, there is no current in the line, the armature falls back immediately the connection of the three points of contact 27, 25, 33, is broken, which is done twice, *id est*, once when the stud 31 is pushed down to the bottom, and once when it is released and resumes its former position; in this case the sound or noise of the attraction of the armature is necessarily heard twice. From these movements it follows that the operator will be enabled to be sure at each pressure of the stud whether the current has passed through the line or not, for in case he hears the speaker sound twice when pushing down the stud, in spite of the contact at the point 28 in the manipulator, he is warned that the current is stopped, either by accident or by the actions of the telegraphist at the end of the line, and he stops telegraphing and puts his apparatus in readiness to receive.

With reference to the functions of the reinforcer, it will be seen that it serves to print the character to be transmitted at the receiving office.

FIG. 1.



The receiving apparatus is shown in end and side elevation by figs. 2 and 3, and in plan by fig. 4.

The line current passes direct through the electro-magnet 37. At each side of, and near the poles of the latter, are placed vertical electro-magnets 40, 41, with oscillating cores and pole pieces 38, 39; to these pole pieces are attached arms 42 and 43.

At the extremities of the arms are placed pins 44, 45, the pressure of which respectively against the rods 46 or 47, when its arm is in action, makes a contact at the points 48 or 49.

The poles of 38 and 39 are inverse to one another, the effect of which is that the large electro-magnet 37, when it is traversed by a current of ordinary intensity in one direction, moves one of the arms, whilst the other remains stationary, and if the

FIG. 2.

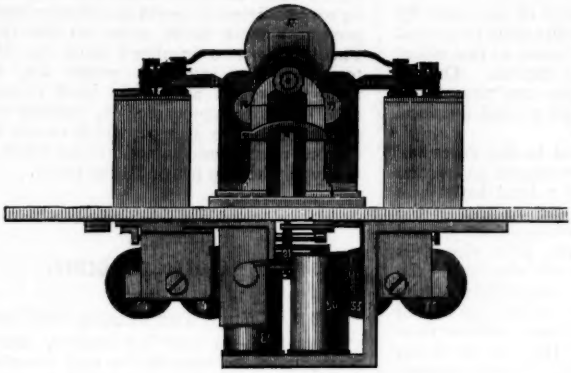


Fig 6

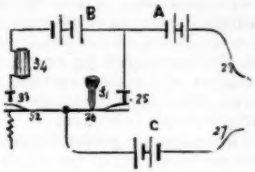


FIG. 5.

FIG. 3.

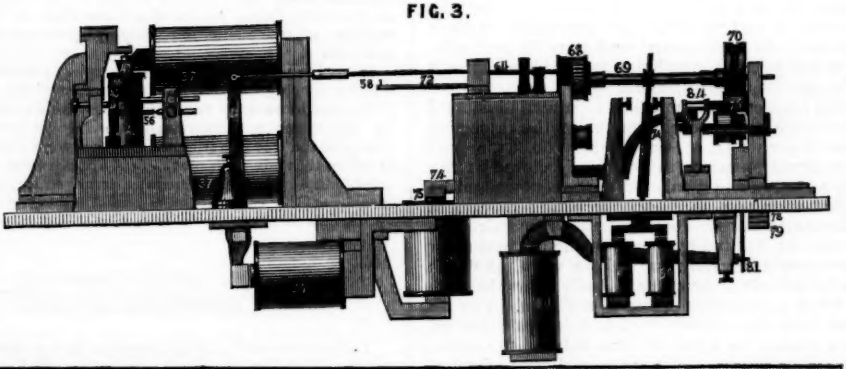
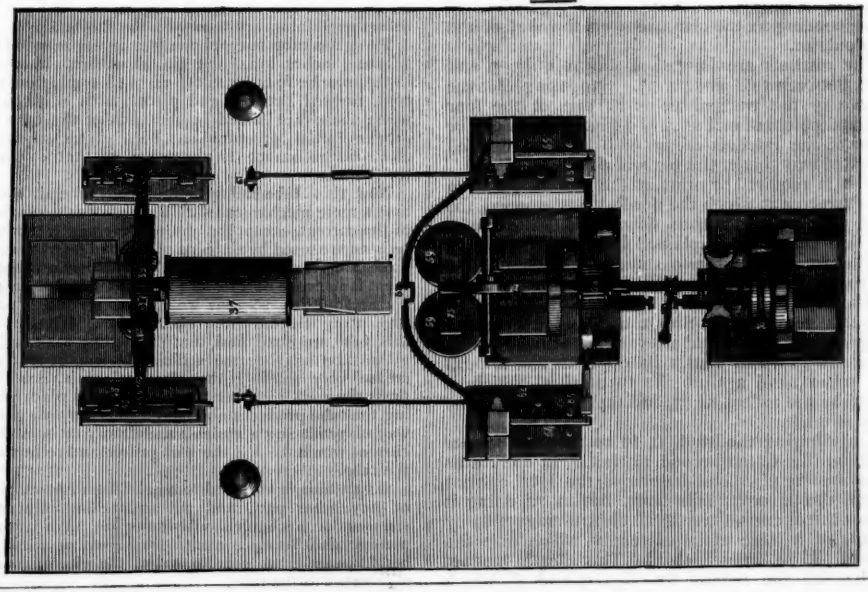


FIG. 4.



current is reversed the other arm is caused to move.

The movement of one or other of the arms by pushing the pin 44 or 45 against the point of contact 48 or 49 closes a local battery circuit, so that either the electro-magnet 54 or 55 is excited. On the cessation of the line current, the arm attracted is drawn back by the springs 56 or 57, and the local battery circuit is broken.

The magnetic power imparted to the cores and pole pieces 38, 39, of the electro-magnet 40, 41, and which is obtained by means of a local battery, is regulated by means of a rheostat, so that if the current which traverses the electro-magnet 37, and which has attracted one of the pole pieces, is greatly increased in strength, it will also attract the other pole piece, because the magnetism of the latter, although it is of the same polarity as that of the pole of 37 opposite it, is very much weaker than the magnetism of the latter. By this attraction both arms 42 and 43 are moved, and both electro-magnets 54 and 55 are called into action, so that the arms 72 and 73, which are connected to their armatures, are both moved, and thus make a contact at the point 58, circulating another local current in the printing electro-magnet 59.

With respect to the printing apparatus illustrated by the same figures, each armature of the respective electro-magnets 54, 55, has an arm 60, 61, moved by its attraction when the circuit is closed at the point 52 or 53, and a counter movement caused by a spiral spring 62, 63. The alternating movement of these two arms is communicated respectively to the arms 64, 65, and by means of the ratchets 66 or 67 working alternately on the pin wheel 68 which runs backwards or forwards. A slight stop beneath the wheel prevents involuntary vibration. The pin wheel turns the axis 69 which is held by an arm 70, and is pushed by it towards one side or the other. The axis 69 bears a double-margined type wheel 71 corresponding to the characters on the dial of the manipulator.

The ratchets are formed as shown in fig. 5, and work between two pins 72, 73. Supposing that the handle of the transmitter is at one of the four optional points of rest 6, 7, 8, 9 (fig. 1), then one or other of the ratchets 66 or 67 will have entered between two pins of the pin wheel.

If it is required to print at the receiving station the character at which the needle 10 is stopped, the stud 31 (fig. 6) is pushed down, and so increases the line current as explained before. The second ratchet 67 or 66, hitherto stationary, then tries to move, but is stopped by the contact at the point 58 of the two extremities of the arms 72, 73 (fig. 4). By this contact the circuit of the local electro-magnet 59 is closed, and a lever 74 is attracted at its armature 75 which causes its opposite end to push the paper band against the type wheel, which is inked by the rollers 76, 77, and the impression of the type is made.

On allowing the stud 31 to resume its former position (fig. 6) the second ratchet 67 or 66 returns to its resting place and interrupts the local current at 58, the lever 74 falls back, but in so doing it closes the circuit of the local electro-magnet 80 by means of a piece at its extremity, which puts the points 78, 79, into contact. This electro-magnet pushes up the ratchet 81 (figs. 2 and 3) which working in a small pin wheel 82 moves the rollers 83, on which the paper band is held by two springs 84 with sufficient strength to make the band pass and present a fresh blank space to the type wheel. Finally, the two insulated arms 64, 65 (fig. 4), touching the insulated points 85, 86, close respectively and alternately local circuits of the small electro-magnets 89, 90, thereby causing an oscillation of the arm 70, which causes sometimes the one margin, and sometimes the other margin of the type wheel to fall on to the paper.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—In your last number, Mr. Frederick Varley gives an account of a very interesting experiment throwing light on the action in one particular of the microphone, but at the same time he fails to explain what causes the varying pressure at the contacts.

It has long been known that a varying pressure produces a varying current, and the action of the microphone would be easy to explain if by a diaphragm or its equivalent a mechanically varying pressure was arranged for, but in a true microphone every precaution is taken that no such mechanical arrangement should exist, and a constant pressure is arranged for, even by insulating the carbons in a sealed glass tube from aërial disturbances.

The glass sealed tube microphone being one of the most perfect for the human voice, should be studied before explaining any theory on the subject.

The glass tube microphone (see figure) is made from a tube 3 inches long, and ¼in. diameter. It contains in the interior four loose cylinders of conducting charcoal, pressed between end pieces, with a conducting wire: these are sealed in the ends of the tube after proper initial pressure has been given, so that its electrical resistance is about half of that of the exterior line.

Now this tube being hermetically closed, we find that a mere mechanical shaking produces no variation of the current, except that due to a constantly increasing resistance caused by abrasion of the carbon contacts. If in shaking it we force one of the cylinders on one side, there is increase of pressure on that side but decrease on the opposite, so that we cannot produce a perfect undulatory current from such action. If we observe this tube, we shall find that by pulling each end, the glass tube has become sufficiently lengthened to increase very sensibly the electrical resistance; if we press the ends together the reverse takes place; bending the tube produces no change, thus the only possible way of producing a variable undulatory or intermittent current would be by the elongation and retraction of the tube.

If this tube is attached to a solid board at its centre, or any other part, and put under the influence of sonorous or mechanical vibrations, we have at once a perfect undulatory current, whose wave form and height is an exact counterpart of the vibrations communicated to the tube.

Knowing as we do that this varying current can only be produced by a varying length of the glass tube, it becomes necessary to examine this point; evidently the tube does change its dimensions under the influence of sonorous vibrations, and we cannot suppose that the tube has lengthened without admitting that each molecule that it contains has undergone its proportionate change of form. If it was not so the tube in lengthening would be broken if there was no elasticity and consequent freedom of action of the molecules of the glass tube.

I shall be very happy to listen to any other explanation than the one I have already given, but it must be one that explains all the phenomena of the microphone as perfectly as the molecular theory I have advanced.

Sincerely yours,

D. E. HUGHES.

H. A. W. FANSHAWE.—We are obliged to you for having pointed out the existence of an error in the formula in question, so that we have been enabled to correct it. The substitution of a symbol for the expression you mention would no doubt have enabled the equation to have been inserted in column width, but would not have enabled it to be solved numerically with greater ease.

With further reference to the algebraical problem, we must point out that if the equation $A = \frac{a}{a+b} F$ be true, then A is quite independent of c and d; or, in other words, if we suppose c to be constant, then if d be increased or diminished, no alteration will be produced in A, which is clearly not the case.

Your arrangement for working Sieurs' double transmission system would not work in practice for two reasons: first, the lever would not oscillate between the two stops but would simply quiver on the stop l_1; and, secondly, the pole of the battery connected to l_1 would be permanently to earth through the sounder coils and local battery.—EDIT. TEL. JOUR.

Review.

Elettricità e Magnetismo. By RINALDO FERRINI, Professor of the Regio Istituto Tecnico Superiore of Milan. Illsico Hœpli, Milan.

THIS work, to a great extent both in name as well as in contents, may be considered as an Italian edition of the work of Professor Clerk Maxwell; but at the same time the extent of ground covered is greater than is the case in the treatise of Professor Maxwell, as under the head "Electricity and Magnetism," the Electric Telegraph, Electro-metallurgy, the Application of Electricity for Blasting Purposes, Electric Lighting, the Telephone, &c., are included.

Although it is of course impossible, even in a volume of 600 octavo pages, to thoroughly consider all the subjects treated of, yet the amount of information given in M. Ferrini's work is very great, the matter being judiciously chosen and well put together; moreover the information is well up to date; the quadruplex is, however, not described.

From the nature of the work frequent extracts from foreign publications have been inevitable, but in all cases Mr. Ferrini has acknowledged his indebtedness. We observe that extracts from the *Telegraphic Journal* occur in several places throughout the work.

Illustrations, considering the size of the work, are not numerous, but are inserted wherever necessary.

Altogether the work is a highly creditable production, and is one of which Italian electricians and physicists may be proud.

Notes.

THE TELEPHONE.—It is rumoured from Paris that an improvement of great importance has been made on the Bell telephone by Messrs. Gower and Roosevelt. By it it is possible to hear a telephone speak when held several feet from the ear.

M. DUMONT gives the following description of a new telephone transmitter presented by him to the French Academy: A parchment membrane, 12 centimetres in diameter, is stretched upon a vertical hoop. To the centre is fixed a wire retained from one side by a knot, and which, first running horizontally from the other side, envelopes a pulley and supports at its lower extremity a small cone of brass suspended by a hook fixed at the centre of its base. This piece relatively heavy enough (20 grammes), plunges its point to a depth of about 1 millimetre into a metal cup filled with carbon dust. This cup is fixed upon the wooden base of the apparatus which supports the membrane. One of the poles of a battery of four Leclanché elements is in communication with the metal cone, the other pole communicates with the metal cup containing the powdered graphite or carbon. The smallest vibrations impressed upon the membrane by sonorous waves suffice to modify, through the intervention of the pulley, the pressure of the cone on the carbon dust, and so determine telephonic variations of current which can be received in a Bell telephone.

IT has been proposed by M. de Parville to apply the well-known fact that a long bar of soft iron held in the magnetic meridian can be employed instead of the magnet in a telephone, to the determination of the magnetic meridian. The telephone so constructed gives its loudest effect when the bar, which should be a metre long, is in line with the magnetic meridian, and when it is at right angles to the meridian the sound is more or less completely silenced. This plan he thinks might be useful on board ship, for compass correction, when the magnetic influence of rocks falsifies the readings. M. de Parville also proposes to utilise the temporary magnetism in a soft iron bar in order to trace out the different courses taken by a ship by an automatic dead reckoning. For this purpose, he would fix a rod several metres long in the axis of the ship, with a coil fixed on one extremity, and the feeble induction currents generated in the latter as the ship changed her direction would be caused to operate a delicate inking arrangement similar to that of the siphon recorder.

THE only grand medals awarded for electric inventions at the Paris Exhibition have both been carried off by Americans. They have been given to Mr. T. A. Edison and Mr. Elisha Gray for the invention of telephones. Mr. Elisha Gray deserves a considerable share in the honour of inventing the first speaking telephone,—more than he obtained to begin with; but if the French award means that he is the true and sole inventor of the speaking telephone to the exclusion of Prof. Bell it gives him more than his due. Gray invented the electro-magnetic receiver, perhaps a

little before Bell, but it was Bell who made the electro-magnetic transmitter, and produced a complete electro-magnetic telephone. In fairness the honour should at least be divided betwixt these gentlemen.

EDISON'S carbon telephone has been adopted by the Gold and Stock Telegraph Company, New York, to work on a central office system whereby subscribers can converse with each other by wire.

ACCORDING to *Dingler's Polyt. Jour.*, MM. Serpieri and Cappanera have studied the sounds which are only imperfectly transmitted by the telephone, and find that there is a frequent confusion of the following sounds:—*e, a; tr, cr, dr, pr, fr; n, m; s, f; et, el; eb, eu; d, t; ic, ip; dra, tra, gra; te, chi; at, ai; i, u; l, r; o, e; v, b.*

THE STRING TELEPHONE.—Mr. N. R. Huntley, an engineer of Springfield, Mass., U.S., has so far perfected the toy telephone as to talk plainly across the Connecticut river, a distance of 2,450 feet, or nearly half a mile. The boxes have thin iron diaphragms. The line is not straight but zig-zag, and is supported by iron pins fitted with glass insulators, which prevent the sound from leaking. He fully expects to make a serviceable private telephone out of this arrangement.

Mr. F. G. LLOYD, who simultaneously with Prof. Hughes, has been investigating the production of sound in the telephone and in electro-magnets, thus describes in *Nature* a receiving telephone made by him without a diaphragm:—Two ordinary electro-magnets (unscrewed from a couple of large electric bells) were fastened, by means of two little wooden saddles and a screw each, to a small piece of deal board about 4½ inches square and ⅝ inches thick, in such a way that the poles were all but touching. Their wires were then joined so that poles of opposite denominations faced each other; *i. e.*, north opposite south, and *vice versâ*. This placed on an empty cigar-box and four Leclanché cells in circuit (with a transmitting microphone) gave out the tune of the musical box clearly and loudly in the room. When both poles were made to touch, the sound ceased; but with a thin piece of paper or stout tinfoil between them, without any intervening air space, the sound was heard. On gradually separating the magnets, the sounds grew fainter and fainter, till they became inaudible. By putting the base board close to the ear, whistling, singing, and talking to the microphone, were clearly distinguished.

THE MICROPHONE.—The original microphone of Prof. Hughes has, we believe, been deposited in the museum of the *Conservatoire des Arts et Metiers*. It is a matter for regret that we have no similar high-class depository in this country for such interesting memorials of scientific labours, and that the first model of this important English invention should not have found a place of honour in England. We trust that before long the Society of Telegraph Engineers will be provided with a museum as well as a library worthy of it. The Patent Office Museum, that lumber-room of old firearms and antiquated beam-engines, is out of the question for such a purpose as this.

A PIECE of ordinary black-lead pencil sharpened at both ends acts very well as an upright piece in the pencil mierophone. It is very light and sensitive even when fitted into brass sockets.

MR. COLLISON, an electrical mechanic of Glasgow, informs us that he has made a very sensitive microphone of a diamond-shaped slip of aluminium foil for the upright piece and two carbon blocks for the sockets.

MR. THOMAS ROWNEY finds an increase of volume of the sound heard in the telephone of a microphone circuit when the microphone is placed *between* two pairs of elements.

VARIATIONS OF CURRENT STRENGTH BY PRESSURE OF CONTACTS.—It was found by De la Rive that when the circuit of a Faraday or Ducretet electro-magnet is closed between its two poles no spark or sound is observed, but, on the contrary, when the circuit is opened a crack like a pistol-shot is heard. In 1874 it was shown by M. Trève that the same phenomenon, though in a less degree, took place in opening the circuit near a single pole of the electro-magnet, and, further, that the influence of that single pole equally determined the instantaneous stoppage of the little cube of copper originally rotated between the poles. In a recent communication to the French Academy of Sciences, M. Trève points out that this experiment of De la Rive is an excellent means of showing to a large audience the influence of the pressure existing between two contacts on the intensity of the current traversing them. The ends of the wires of the electro-magnet are held in the hands between its poles, and the noise attending the opening of the circuit can be varied considerably by bearing more or less strongly on one thread or the other. This noise, which is hardly perceptible when the two wires touch each other lightly, becomes like the report of a pistol when they are forcibly pressed together. Equally curious effects are to be noticed on making contact with pointed wires.

AN amusing sceptic of the phonograph and the telephone has appeared in the person of M. Bouillard, who, in a paper to the Physical Section of the French Academy, recently gave it as his opinion that Count Du Moncel's exhibition of the phonograph was supported by ventriloquism, and that the telephone is an acoustic illusion. The phonograph, telephone, and microphone have already become so familiar to us that we would be in danger of forgetting how marvellous they seemed to all when first announced, were it not that M. Boullard stands forth as a refreshing reminder of the fact.

THE ELECTRIC LIGHT.—The *Times* office is to be lit by M. Rapieff's electric light. Six lamps have been fitted up in the printing room, and others will be introduced into the compositors' room. It is likely to prove very beneficial to the type setters who work by night in a hot and vitiated atmosphere.

IT is rumoured that a company of leading electricians is about to be formed to introduce the electric light into London.

THE electric light continues to progress in Paris. Fourteen new lamps have been added to the sixteen already existing in the Avenue de l'Opéra. These thirty, together with those in the Place de l'Opéra at one end of the avenue, and those in the Place du Théatre Français at the other end, make fifty-eight lamps in view at once, illuminating one of the most splendid thoroughfares of Paris.

It is said that 400 horse-power are employed in supplying the 180 electric lights now glowing nightly in Paris.

THE Danish Government have decided to light up the ports of Copenhagen and Elsinore, together with

the whole length of the Sound, by electric light. This resolve on the part of the Danish Government is worthy of an enterprising and enlightened people, and as it will be a benefit to Baltic trading ships, we hope to see their example followed by other nations. We trust the time is near at hand when the overcrowded Thames below London Bridge will be nightly illuminated by electricity.

IT is said that the cost of the five Lontin electric lights now illuminating the outside of the Gaiety Theatre and a large part of the Strand, is only 2s. 6d. an hour.

MESSRS. TASKER, SONS AND CO., of the Electric Works, New Station Road, Sheffield, have been publicly exhibiting the electric light at their works there, and have awakened much interest in it amongst the residents of that town.

THE Vestry of Ayr have resolved upon having another and more decisive trial of the electric light in that town.

IN a note of our issue for Sept. 15th, we alluded to a statement in the *World* to the effect that M. Jablochkoff had asked £350,000 from Mr. Hollingshead for his rights to the electric candle system of lighting in England. This statement is difficult to understand when on consulting Jablochkoff's English patent for the electric candle (No. 3552, dated Sept. 11th, 1876), we find the following notice on the title page, "*void by reason of the Patentee having neglected to file a specification in pursuance of the conditions of the letters patent.*" Will some reader kindly explain this?

MR. HOLLINGSHEAD, the introducer of the Lontin light at the Gaiety Theatre, Strand, is now advertising for steam power (from 20 to 200 horse-power) required immediately for this light in the following thoroughfares: Strand, Piccadilly (central), Oxford Street, Holborn, Tottenham Court Road, Euston Road, and Aldgate.

FROM August 8 to October 11, eleven patents for electric lighting were taken out in England, including patents by Siemens, Wilde, and Lane Fox, but apparently none from Mr. Edison till then. It is curious to note as an index of the effect of public excitement on invention that six of these eleven patents were taken out from October 4 to October 11, during the Edison "scare."

AT the half-yearly general meeting of the London Gas Light Company, held on Wednesday, Oct. 2nd, at the Freemason's Tavern, Lincoln's Inn Fields, Mr. John Leng, editor of the *Dundee Advertiser*, urged the gas companies to take up the electric light as an auxiliary to gas lighting. It was generally admitted that the electric light would be one of the lights of the future, and was not to be repudiated or ignored.

AT the half-yearly general meeting of the Phœnix Gaslight and Coke Company, held on Wednesday, October 2nd, at the Bridge House Hotel, London Bridge, Mr. Edward Horner, the chairman, testified to the indubitable beauty and power of the electric light, but gave his opinion that the gas companies had no reason to be "scared" at it, since the question must resolve itself into one of cost. He then gave the following figures as resulting from his recent visit to Paris. At one of the large hotels there they were wont to have 48 gas lights, which at the rate of the Phœnix Gas Company's (3s. 4d. per 1000 feet) amounted to 4s. 10d. a night. Instead of these 48 gaslights, electric lights were now used at a cost of £1 13s. a night. The Avenue de l'Opéra was estimated to cost for gas £885 a year, whereas the estimated cost of the electric light for the same number of hours was £10,625. Shareholders should also bear in mind that of all the business done by gas companies in London that of street lighting was of the least consequence; in their own case he estimated that 1d. per 1,000 feet over the whole concern should cover the whole public lighting of this company. He thought there was nothing to fear from the electric light which was "utterly unmanageable," whereas gas was "perfectly under control." This statement about the value of street lighting to the gas companies is a very important one, as affecting these companies, and appears to mean that the whole proportion of gas used in street lighting amounts only to 1 per cent. of the total supply; and consequently that if all street lighting were done by electricity it would only reduce the gross revenue by about 1 per cent. The chairman also said, as regards the gas companies taking up the electric light, that he feared that it would be found that they had no Parliamentary powers to do so.

THE ordinary half-yearly general meeting of the South Metropolitan Gas Light and Coke Company was held on Oct. 7th, at the Terminus Hotel, London Bridge Station. The rivalry of the electric light was regarded in a hopeful spirit by the manager, Mr. Mivesay, who said that he should like to see certain prominent points of London, such as the Mansion House and the corner of Queen Victoria Street lit by it; but thought that it was not at all suited for public streets, a diffused light being required for such a purpose, and that the electric light could not be diffused. One insuperable objection to the light was, in his opinion, its intensity: and therefore its unsuitability for ordinary lighting. He confessed he had been disappointed with the intensity of the light at the Gaiety Theatre. One shareholder said that the electric light had been successfully applied in Paris; and another gave it as his belief that if ever the electric light should come into vogue there would be plenty of work for the oculists. A dividend of 11½ per cent. was recommended, and the report stated that the price of gas had been reduced to 3s. per 1000 feet.

COST OF THE LIGHT.—In a letter to the *Times* of October 4th, Mr. John Blount, M.I.C.E. stated that he had learned from the Societé General, which conducts the lighting of the Avenue de l'Opéra, Paris, that the cost of each electric lamp (Jablochkoff's system) per hour is 6·25d. not including interest on capital or repairs. The price paid by the Paris Municipality is 13·8d. per lamp per hour. The nominal value of each electric candle is put at 100 gas burners, consuming 140 litres or 5 cubic feet of gas per hour; but Mr. Blount thinks the practical value much lower than this. To compare the cost of the two kinds of light better, he takes Sloane Street as an example. (See also Mr. Stayton's Report in the TELEGRAPHIC JOURNAL for Sept. 1st.) It takes 2s. 1½d. per hour to light with gas the 42 gas lamps in Sloane Street. If 8 electric lights were substituted for these, the cost would be 4s. 2d. per hour, or adding interest on capital and maintenance to this about 5s. per hour. At the price paid in Paris for gas (about 7s. 6d. per 1000 cubic feet) the cost would be 9s. 2d. per hour. It is needless to say that the electric light would be much superior to gas light.

IN the *Times* for Saturday, Oct. 5th, Mr. John Hollingshead timely points out that estimates of the cost of the electric light made on the basis of Jablochkoff's system, the "most expensive light in Europe," do not fairly represent the question. With Lontin's light he is prepared to illuminate large halls

and areas at half the cost of gas, while giving 12 times the amount of light.

AN electric gas-lighting apparatus, the invention of M. Hausmann, has recently been patented in Germany. The gas cock is opened and closed by an electro-magnetic arrangement, but the lighting is done by a small gas jet kept constantly burning over the gas burner, and at right angles to it.

ANOTHER electric lamp-lighting system is being tried in Pall-Mall.

A pneumo-electric gas lamp-lighting apparatus is being tried at Baltimore, U.S. In addition to the gas pipes, another pipe, containing the conductor and the compressed air, is required. The air is compressed at a central office and being forced through the pipes closes the battery circuit in the different lamps, turning on the gas and generating a spark sufficient to ignite it. The cost of the apparatus, including the pipe and labour of installation, is put down at 40 dollars each lamp.

TELEGRAPHIC fire alarms, under Symington's patent, are being rapidly introduced into the streets of Glasgow. In a short time the system will be complete over the whole city. Perhaps the metropolis will then follow the Glasgow lead.

IT is stated that the merchants of New South Wales are endeavouring to obtain a duplicate cable to Europe. One of the routes suggested is from the North West Cape to San Francisco, which would require two millions sterling to lay over. Any company which would take the matter up would be guaranteed an annual subsidy of £75,000 by the New South Wales Government. We also hear that a light cable between Freemantle and Rotnest Island, Western Australia, is a desideratum.

RULE No. 8 of the Green Bay and Minnesota R. R. Company, of which Mr. E. C. Belknap is train despatcher, reads "Students in telegraphy will not be tolerated on the lines of this Company." — *The Operator*, U.S.

AT a "cable conference" held in Melbourne in May it was agreed that the subsidy of £32,400 to be granted annually to the Eastern Extension Telegraph Company for twenty years for the duplicate cable to be laid between Singapore and Banjoewangie, should only become payable after a second cable between Singapore and Penang was laid. The Eastern Extension Telegraph Company are also requested to reduce their charge for Governmental messages 50 per cent., and for press messages 75 per cent. on the present rates. Provision is also made for the purchase by the combined colonies of the duplicate cable. The subsidy is to be paid by the different colonies ratably in proportion to their respective populations as shown by the 1876 estimate. Arrangements for constructing a duplicate trans-continental line from Port Darwin to Queensland were also taken into consideration. The new Singapore to Port Darwin cable and the Singapore to Penang cable are to be laid within eight months from the date of the agreement, and to hasten the work the subsidy is to commence from four months after signing the agreement. Should both lines be silent at any time, the subsidy will cease *pro rata* for the period of interruption, unless the cause be war. Press messages must be addressed to licensed newspapers only; they must be in plain English, no cypher or code being employed, so that the press privilege shall not be abused by commercial messages.

PARIS EXHIBITION awards of the second class have been obtained by Messrs. Siemens Bros., The Telegraph Construction und Maintenance Company, and the Smith Vacuum Brake Company.

THE Lords of the Admiralty have purchased the new iron screw steamer *Stuart*, which has been built in Scotland for the use of the Indo-European Telegraph Company. The *Stuart* is to be fitted out as a store and troop ship.

LIEUT.-COL. MURRAY, of the Bengal Staff Corps, has been appointed Director of Indian Telegraphs.

MR. SIEVEWRIGHT, general manager of the Cape telegraphs, has proceeded with Governor Frere to Natal to superintend the protection of the new land lines in Natal and the Transvaal.

AT a conference of the officers of the Direct Cable Company, held at Portsmouth, New Hampshire, U.S., on September 5th, it was decided to change the bed of the cable leading from Rye Beach, and lay it further off shore so as to clear the fishing waters.

THE yellow fever pestilence in the Southern States of America has been playing sad havoc amongst the telegraph operators, many of whom nobly remained at their posts and thus enabled communication to be kept up with the outer world and help to be rendered or tidings to be sent. The Telegraphers' Aid Association are nursing all sick operators, irrespective of the company they belong to. About 9,000 dollars were subscribed up to September 15th for their relief, and branches of the association established at New Orleans and Memphis, the head-quarters of the fever. The Western Union Telegraph Company have agreed to pay the nurses' bills of any of its operators struck down with the disease. Subscriptions from the general public are also coming in.

THE cottonwood telegraph poles along the Southern Pacific Railway, U.S., are reported to have sprouted, and promise to form a line of shade.

THE TELEGASTOGRAPH.—A paragraph has been going the rounds of the newspapers of late concerning a new electric invention called the "Telegastograph." It consists of a device for transmitting taste by wire, and enabling a *bon vivant* to enjoy all the rich flavour of a feast without the attendant headache next morning. Thus, nice little dinners can be arranged on the Barmecide principle by ambitious middle-class householders, and without the necessity of calling in the services of the neighbouring greengrocer. We cannot see anything very funny in this much-quoted parody of recent electrical marvels, and it may strike many an underpaid operator and unemployed electrician as a sorry joke to suppose that electricity could satisfy any one's appetite.

MR. EDISON has returned from his vacation, and already announces two more new inventions—the sonorous voltameter, an instrument for measuring the strength of telegraph batteries, and a new ink by which blind people will be enabled to communicate with each other. He says he enjoyed his trip through the Far West, and tells a story of being tracked on one occasion by a scout (carrying him a telegram) over a distance of eighty miles, the scout having nothing to guide him but tobacco-juice. "Sharp fellows these scouts," adds Mr. Edison.—*The Operator, U.S.*

IN the sonorous voltameter the noise of the bubbles rising is magnified by a funnel, and by counting the number of ticks made by these bubbles per second, the strength of the current is obtained.

The blind ink makes at first a grayish white mark, but soon swells up into relief on the paper, and can then be traced by the touch of the fingers.

Edison is also reported to suggest the following plan for telling the extent of gold ore in mines. The ore is

generally surrounded by a conducting bed such as clay, and his plan is to test the "earth" between the clay at the bottom of the mine and the upper soil. If the clay bed is extensive, the earth will, according to Mr. Edison, be a good one, and an extensive clay bed means it appears, a great deal of ore.

THE TELEGRAPH IN MANITOBA.—The telegraph along the line of the great Canadian Pacific Railway from Fort William on Lake Superior *via* Selkirk in Manitoba and the Leatherhead Pass to Burrard Inlet, on the British Columbian Coast is being rapidly pushed forward. Over 1,000 miles of it have been already built on the two western sections; the total length of the route being 1,946 miles. Where it runs through woodland, the width of the clearance for the railway is 132 feet. The reports of the chief engineer, descriptions and maps of the country, with other documents relating to the line, can be had or seen at the Canadian Government Office, 31, Queen Victoria Street, London, E.C.

TOMMASI'S RELAY ON THE FRENCH ATLANTIC CABLE.—The delicate relay invented by M. Tommasi, fitted with a small mirror which exhibits the deviations of the magnetised tongue on a screen, after the manner of a Thomson galvanometer, was tried at Brest on the French Atlantic Cable last July. The relay so provided is designed to operate the Hughes' printer through long submarine cables. Owing to a difficulty in getting mirror reading clerks, M. Tommasi states that he caused the single letter N to be indefinitely repeated through the cable from St. Pierre. The results are given as follows:—With a battery of 15 Minotto cells the letter N could be repeated 128 to 130 times a minute with great deflection of the image. With a battery of 10 elements 98 repetitions were obtained; with five elements 88 repetitions. With a battery of 30 elements and 10,000 units added to the resistance of the cable (7,500 units) 108 repetitions a minute were obtained with a deflection of about 5 centimetres on each side of zero. Similar results were obtained with the letter R. These trials took place before the Superintendent of the Anglo-American Telegraph Co. at Brest; condensers being employed at each extremity of the cable.

TERRESTRIAL MAGNETISM AND THE POLARISATION OF LIGHT.—M. Henri Becquerel while experimenting on rotary magnetic polarisation, recently found that if a tube, containing bisulphide of carbon is placed between a polarizer and an analyzer in the plane of the magnetic meridian, there is an angular difference of 6·5′ between the two positions of the plane of polarisation when looking towards the south or towards the north. He attributes this difference to the action of the earth's magnetism.

PONCI'S BATTERY.—This new cell, the invention of an Italian professor, consists of a glass jar and porous pot, the former containing a solution of ferric chloride, in which is immersed a carbon plate, and the latter containing a solution of ferrous chloride in which is immersed an iron plate. Both solutions should be made to a strength of 35 degrees of Baumé's scale. The electro-motive force of an element is about $\frac{9}{10}$ of a Daniell.

DISCHARGE IN GASES.—According to the recent researches of Drs. Warren de la Rue and Hugo W. Müller with electrodes of plane or slightly convex surfaces the potentials necessary to produce electric discharges in gases at various distances are not proportional to the distances when these are small (less than 0·025 inch), but tend to become so as the distances are increased. These results agree with those of Sir William Thomson.

New Patents.

3367. "Galvanic batteries." J. C. FULLER, F. H. W. HIGGINS. Dated August 16.

3428. "Ship Telegraphs." J. S. GISBORNE. Dated August 30.

3470. "Improvements in obtaining light by electricity, and in the means or apparatus employed therein." C. W. HARRISON. Dated September 2.

3518. "Improved electrical apparatus for igniting illuminating gas." A. R. MOLISON. Dated September 5.

3528. "Improvements in the manufacture of magnetic clothing, such as belts, lung invigorators, knee caps, &c., &c., applicable to any part of the body." W. WILSON. Dated September 6.

3603. "Flexible electric conductors and tips therefor (for telephones &c.)." G. J. STANFORD (communicated by E. F. Phillips). Complete. Dated September 12.

3622. "Submarine electric telegraph cables." W. SMITH. Dated September 13.

3642. "A new improved apparatus which in combination with an alarm will light a lamp at any desired time." W. E. GEDGE (communicated by G. Devillers). Dated September 16.

3647. "Improvements in and appertaining to transmitters for telephones." H. HUNNINGS. Dated September 16.

3652. "Improvements in machinery for changing an original direction of motion to any angle desired; applicable to marine engine room telegraphs and other purposes." A. MECHAN. Dated September 16.

3656. "Improvements in the manufacture of electrodes for electric lighting, and in the manner of partially protecting the incandescent points from oxidising or destructive action." A. H. P. STUART-WORTLEY. Dated September 17.

3676. "An improved construction or arrangement of magnets and armatures for the purpose of producing rotary motion or obtaining motive-power or a magnetic current for any of the various purposes for which such current may be applicable." H. E. NEWTON (communicated by H. G. Hosmer). Dated September 17.

3707. "Galvanic batteries." C. E. BASEVI. Dated September 19.

3713. "Galvanic batteries." J. D. ADAMS (communicated by A. Niaudet). Dated September 19.

3750. "Electrical signs for advertising purposes." J. S. BLACKMER. Complete. Dated September 23.

3837. "Electric light apparatus." A. LONGSDON. (Communicated by A. Krupp). Dated September 28.

3744. "Rudder motion indicator and telegraphing on board ships by electricity." E. A. CAMINADA. Complete. Dated September 21.

3804. "Speaking telephones." J. F. BAILEY (communicated by E. Gray). Complete. Dated September 27.

3892. "Telephones." J. H. JOHNSON (communicated by F. A. Gower and C. Roosevelt). Dated October 3.

3985. "Electric Lighting." H. W. TYLER KNIGHT. Dated October 9.

3988. "Improvements in obtaining light by electricity and in conveying, distributing, measuring, and regulating the electric current for the same, and in the means or apparatus employed therein." S. & G. L. FOX. Dated October 9.

3991. "A new or improved method of adapting the electric light to domestic and other ordinary purposes." J. CLARK. Dated October 9.

4006. "Electric lighting apparatus." P. JENSEN (communicated by S. Marcus). Dated October 10.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

58. "Electric Telephones."—GEORGE STEPHENSON. Dated January 4, 1878. 2d. This consists in placing the vibrating plate of an electro-magnetic telephone between the two poles of the magnet, each pole being fitted with a soft iron pole piece. *Not proceeded with.*

125. "Telegraph Alarm Apparatus."—W. P. THOMPSON (communicated by Sigismund Mohr, Quebec, Canada). Dated Jan. 10, 1878. 2d. This consists in an arrangement whereby fire or other alarm telegrams are responded to, so that the sender is assured that his message has been correctly received. A switch is arranged so that the current can pass through the bell, or through the contact maker, worked by clockwork in such manner that a series of breaks of contact are formed by the spring contact maker coming against notches in a revolving wheel, the spacing apart of these notches being varied so as to give the required signals. Or the switch can be arranged so as to continue the circuit direct. *Not proceeded with.*

131. "Electrical Cables."—DANIEL GÖLLNER, Batavia, Java. Dated January 10, 1878. 2d. This consists in a means of preventing the destruction of submarine cables by marine insects by covering the core with india-rubber, raw or vulcanised, by winding it in ribbons round the core, and cemented so as to form a tubing. *Not proceeded with.*

162. "Producing and applying magneto-electricity."—W. R. LAKE (communicated by James J. McTighe, Pittsburgh, Penn., U.S.) Dated January 12, 1878. 6d. This invention consists in producing currents of magneto-electricity in coils by the vibratory motion of one or more magnetic poles in the vicinity. These vibratory currents can be utilised to reproduce vibratory motions or for telephonic purposes. One mode of producing the currents is to act upon a thin magnetic pole by a toothed wheel so as to set it in vibration when it generates undulatory currents in the coil beside it. The vibrations of the voice or the force of a steam jet may also be used to vibrate the thin pole, which can be made in the form of a vibrating diaphragm. Economy of power is claimed for this method, as it will not be necessary, for the production of intense currents, to whirl large masses of iron. A speaking telephone, consisting of a tubular magnet bent into a horseshoe form and having the coil between its poles is also described. One end of the tube is an open mouthpiece, the other end is closed by a vibrating iron diaphragm which vibrates before the coil, the latter being fixed to the other pole.

191. "Appliances for utilising and conveying sounds or signals from telephonic or sound-producing instruments."—G. E. PRITCHETT. Dated January 15, 1878. 8d. This consists in means for increasing the audibility of telephonic or phonographic sounds so that several persons may hear them simultaneously. This is done by funnels or caps, single or with branching tubes, fitted to the mouthpieces of the sound emitters, and having other ear pieces applied to the ears of the auditors.

General Science Columns.

GEORGE PARKER BIDDER, the famous "calculating boy" and eminent engineer, died on September 20th. He was born on June 14th, 1806, in Moreton Hampstead, Devon, where his father was a mason, and when but a few years old gave signs of his wonderful faculty for computing. Through this peculiar gift, which Bidder in after life, not very convincingly, attributed to practice and training, he became acquainted with Robert Stephenson, who befriended him. He entered an insurance office for some time, but afterwards changed to the Ordinance Survey, and from that to Civil Engineering, becoming assistant to Robert Stephenson in 1831, with whom he participated largely in railway works both at home and abroad. He was engineer of the Danish State Railway, consulting engineer of the Delhi, Scinde, and Punjaub lines, and in hydraulic engineering he constructed the Victoria Docks. He applied the telegraph to railway purposes on the Blackwall and Yarmouth railways; he was one of the founders of the original Electric Telegraph Company, and remained a director of it until 1870, when the Government took over the system. Bidder was president of the Institution of Civil Engineers during 1860-61.

MR. JOHN PENN, the eminent Greenwich engineer, also died at his residence, the Cedars, Lee, on Sept. 23rd. He was born in 1805, became an F.R.S. in 1859. He was a past president of the Institution of Mechanical Engineers, and a member of the Institute of Civil Engineers.

THE foundation stone of the Forth Bridge has been laid, and the works were begun on Oct. 1. It will comprise two great spans of 1,600 feet each, and will take four years to complete.

IT is stated that an international exhibition of machinery will be held next year in the Palais de l'Industrie, Paris.

A NEW SOUNDING APPARATUS.—This sondograph, as it is called, is the invention of Lieut. Pereira Pinheiro, of the Brazilian navy. It is designed to give a continuous delineation of the bottom of the sea along the line on which it is operated. It is only suitable for sounding undulating bottoms, such as the shifting sandbanks and shoals off the mouths of the Brazilian rivers, and is not designed for rocky or broken ground. It is composed of an indicator which takes cognisance of the contour of the bottom, and a register furnishes a graphical trace of it. The indicator is formed of a wooden stem, fitted at its lower extremity by a hollow roller, which rolls upon the bottom, and retains specimens of it for examination. This stem is articulated at its upper extremity around a horizontal axis, which carries a graduated arc intended to show the different inclinations that it takes for the given levels of the bottom, which depend on the versines of these angles. On the same axis is a toothed wheel, which by a pinion and eccentric communicates a rectilinear movement to a style, which traces over a band of paper put in movement by a chronometric motor, a continuous curve, which gives in this way the graphical relation of the changing levels and the speed of the ship. As the direction and speed of the ship can readily be determined, a section showing the soundings along the ship's route can be plotted. M. Pinheiro's sondograph may become useful in hydrographical work at the mouths of rivers subject to sandbars and shifting channels.

THE DIURNAL OSCILLATION OF THE BAROMETER.—M. Renou has recently communicated to the French Academy, the following results of his study of this subject. The sun warms the atmosphere which recedes all around and produces a rarifaction over a great circle. This effect is arrested a short time after the maximum daily temperature has been attained, that is, towards four o'clock in the afternoon, and produces a maximum of pressure over all the countries situated, on the one hand, six hours to the west, and on the other hand six hours to the east, or in other words, the countries which reckon ten o'clock in the morning and ten in the evening as local time. The atmospheric wave which

produces this effect follows the apparent motion of the sun and shifts its position with a velocity which at the equator reaches 464 metres per second. This wave by its rapidity and the direction of its movement should produce a higher maximum in the morning than in the evening; it should also give a predominance to the morning or the evening maximum according as the winds blow from the west or the east. The minimum of the night is only a relative minimum comprised between the two maxima of the evening and morning. The barometric pressure at 4 a.m. ought to differ little from the mean of the 24 hours. In reality it is some hundredths of millimetres lower, because of the loss of weight due to dew and other causes. The diurnal movement of the atmosphere necessarily produces a diurnal variation in the direction of the winds, a variation, however, which is difficult to recognize. Easterly winds favoured by the morning wave rise early and end almost at sunset. Westerly winds opposed by the morning wave are often allayed then and swell up again in the evening.

ASTRONOMICAL ART.—We recently drew attention to Winkler's remarkable lunar landscape, now being exhibited in London. Something even more extensive, if not, perhaps, quite so artistic, is to be attempted by an American artist, if he can procure a sufficient number of subscribers. Mr. Henry Harrison, of Jersey city, has already painted a picture of the moon, three and a half days old, and although we have not seen it ourselves, it is so highly spoken of by Dr. H. Draper and Mr. Rutherford, that we do not hesitate calling our readers' attention to the artist's proposed publication. The picture represents the moon with the terminator at Mount Glacier, showing the earth shine on the surface in shadow, in which some of the most prominent features, *i.e.*, the craters Copernicus and Tycho, the Appenine Mountains, and nearly all the "meres" are visible. Having submitted the work, Mr. Harrison tells us, to gentleman of scientific repute, and being encouraged by their favourable criticisms, he has concluded, if a sufficient number of subscriptions can be obtained, to publish a work under the title of "Telescopic Pictures of the Moon" in oil colour chromos (the only medium for fac-simile reproduction of painting) two feet in size, with an image of eighteen inchesi n diameter, in six progressive pictures of the following phases:—

1. Three days' old crescent, terminator at Mount Clacier.
2. Five days' old, terminator at the Crater Katharina.
3. Seven days' old, or first quarter.
4. Nine days' old, sunrise at the Crater of Copernicus.
5. Full moon; and
6. Last quarter. An outline drawing, with letter press description, bearing the names and sizes of all objects, will accompany the work, which will be completed in about a year from the time the first phase has been issued, and will be furnished to subscribers complete for 30 dols., or 5 dols. each plate. The description will appear gratuitously with the last issue. Subscribers should send full name and address to Henry Harrison, P. O. Box 179, Jersey City, New Jersey.—*Nature.*

THE AMERICAN WEATHER SIGNAL SERVICE.—This useful system of weather reporting was established by the late Prof. Henry, and is perhaps the most complete and successful one existing. It is conducted under the superintendence of Gen. Myer, better known as "Old Prob," from the daily bulletins of weather probabilities he has been instrumental in issuing for a number of years. The duty of the Signal Service is to protect the commerce and agriculture of America by weather warnings, and give information as to the state of the rivers, lakes, and atmosphere of the various parts of the Union, Canada, and abroad. Code telegraphy is employed to transmit the data to central offices, and disseminate the results throughout the country. The members of the service are specially instructed at Fort Whipple, in Virginia. Over two hundred officers and men are engaged in the work. At each station observations on the temperature, pressure, and humidity of the atmosphere, the velocity and direction of the wind, the appearance of the clouds, and state of the weather, are taken thrice a day, at hours fixed by mean Washington time, to get simuitaneous results. The reports are published daily in the newspapers, and in what are termed "Farmers' Bulletins." It is said that the degree of accuracy attained in the storm warnings is represented by 88 per cent. The New York signal station overlooks the city and bay, so that its signals are visible from all parts of the harbour. By day, a red flag with a black centre, and by night, a red lantern, over this building, presage foul weather.

STEAM FOR HEATING PURPOSES.—It is stated that a company has been organised in New York to supply steam for heating purposes. Three miles of street mains have been laid, and at present upwards of forty large buildings are heated by the system of pipes, which derive their steam from one boiler five feet by sixteen feet in size. The pipes run through fifteen streets, and over 1,000,000 cubic feet of space is warmed by the steam, which is supplied at a pressure of 30 lb. to the square inch. The steam, in addition to heating purposes, can be used for cooking food, washing clothes, and extinguishing fires. In addition the hot water from condensed steam is furnished to the houses through the same pipes. The cost is said to be much less than that of ordinary fuel.—*Journal of the Society of Arts.*

City Notes.

Old Broad Street, October 11, 1878.

THERE has been very little to report respecting telegraph property during the past fortnight. Prices have had a slightly downward tendency. In the market for gas securities intense excitement has, however, prevailed, the latest quotations for some of the leading stocks showing a very heavy fall. The letter from Mr. Edison to his agent in London, stating he had discovered a practicable way of sub-dividing the electric light, helped considerably to bring about a panic in an already alarmed market. Gas Light and Coke "A" ordinary, 168-173, are now 150-160; Continental Union, which were on Sept. 30th quoted 17-19, are now 14-16; London, 173-178, are now 150-160; Phœnix, 35-37, are now 30-33; Commercial, 175-180, are 145-155; Rio de Janeiro, 22-24 to 20-22; Oriental, 6¾-7¼ to 5-5¼. We hear that, should Mr. Edison not have made the above-mentioned discovery, there have been six patents taken out in London since the 4th inst. for systems for effecting with facility the same object. The attention of electricians will probably now be given to producing the current as cheaply as possible, and also to conveying it to greater distances with less loss of current strength.

In a letter to the *Times* of Oct. 12, Dr. C. W. Siemens describes a new regulator patented by him, for regulating automatically the resistance in the circuits of the electric lamps so that a number of branch circuits, each having a lamp, may be fed from the same machine by constant currents. Dr. Siemens also gives it as his opinion that (notwithstanding Mr.

Edison's telegram) the electric light in our generation will be confined to the larger purposes of signalling, or lighting large areas and halls, while gas will keep its own as an illuminator of rooms and passages, and as a cooking agent. Dr. Siemens also recommends the gas companies to take up the electric light. This letter has helped somewhat to counteract the heavy depression in gas shares due to Mr. Edison's telegram.

The Jablochkoff electric candle has been introduced into the handsome wareroom of Messrs. Wells & Co., iron and marble merchants, High Street, Shoreditch. The light is given out by four of Jablochkoff's opal globe lamps, each holding four candles similar to those in Paris. The dynamo-electric machine is one of Gramme's alternating current machines giving 1000 turns per minute, or about 16,000 pulses of current per minute. An ordinary Gramme is employed in connection with this one. Messrs. Wells and Co., undertake to give all information about the light, and to furnish it to parties applying to them.

The accounts of the Brazilian Submarine Telegraph Company show a profit for the year ended 30th June sufficient to enable the directors to recommend a final dividend of 2s. 6d. per share, making with previous distributions 5 per cent. per annum, and carrying £50,000 to the reserve fund, increasing that fund to £170,000. The dividend will be payable on the 26th inst.

The Globe Telegraph and Trust Company announce that the interim dividends for the quarter ending October 18th, 1878, will be 3s. per share on the preference, and 2s. on the ordinary shares, payable on and after the 18th inst.

The coupons of the Submarine Cables Trust, due on the 15th instant, will be paid on and after that date by Messrs. Glyn, Mills, Currie and Co., 67, Lombard Street, E.C.

On Oct. 2nd the Great Northern Telegraph Company notified the repair of their Nagasaki-Shanghai cable completed, and of their Shanghai-Amoy cable on the 5th instant.

Notification was given on the 1st instant by the Cuba Submarine Telegraph Company that their 1870 cable between Cinfuegos and Santiago, which was repaired in April last, had again been broken. There is, however, no interruption to business, communication being maintained by the duplicate cable laid in 1875.

Under date Oct. 10 the Eastern Extension Telegraph Company notified the restoration of telegraphic communication with Australia; the Java Port Darwin cable is, however, still undergoing repairs, and until these are completed the traffic will be somewhat delayed. Telegrams for Australia and New Zealand accepted as usual *via* Eastern.

The following are the late quotations of telegraphs:—Anglo-American, Limited, 59½-60; Ditto, Preferred, 88½-89½; Ditto, Deferred, 32-33; Black Sea, Limited, 2-3; Brazilian Submarine, Limited, 6⅛-6⅞; Cuba, Limited, 8¾-9¼; Cuba, Limited, 10 per cent. Preference, 15¼-15⅝; Direct Spanish, Limited, 2-2½; Direct Spanish, 10 per cent. Preference, 10-10½xd.; Direct United States Cable, Limited, 1877, 12⅜-12⅝; Eastern, Limited, 7⅛-7⅜; Eastern, 6 per cent. Debentures repayable October 1883, 107-110; Eastern 5 per cent. Debentures repayable August, 1887, 99-101; Eastern 6 per cent. Preference, 11¼-11½; Eastern Extension, Australasian and China, Limited, 7⅛-7⅜; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; German Union Telegraph and Trust, 7⅜-8¼; Globe Telegraph and Trust, Limited, 5-5¼; Globe 6 per cent. Preference, 10¼-10⅝; Great Northern, 7⅛-8⅛; Indo-European, Limited, 20-21xd; Mediterranean Extension, Limited, 3-3⅛; Mediterranean Extension, 8 per cent. Preference, 9⅛-10; Reuter's Limited, 10-11; Submarine, 216-221; Submarine Scrip, 2-2½; West India and Panama, Limited, 2-2¼; Ditto, 6 per cent. First Preference, 8¼-9; Ditto, ditto, Second Preference, 8¼-8¾; Western and Brazilian, Limited, 2¾-3¼; Ditto, 6 per cent. Debentures "A," 85-90, Ditto, ditto, ditto, "B," 86-89; Western Union of U. S. 7 per cent, 1 Mortgage (Building) Bonds; 114-118; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 29½-30⅛; Ditto, 6 per cent. Bonds, 100-103; Ditto, Second Bonus Trust Certificates, 2⅛-2⅜; India Rubber Co., 30-31.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,102,420.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,997,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,800	West India Co. £883,210.
	£	£	£	£	£	£	£	£	£ *b*	£	£	£ *b*	£
Sept, 1878 ...	44,310	10,463	2,600 *	1,048	14,770	38,169	22,151	15,778	... ...	9,660	2,200	... ...	3,792 *
Sept, 1877	43,230	9,357	2,466 †	812	15,940	35,440	22,113	18,445	... ...	10,029	1,625	9,504	3,800
Increase	80	1,106	134	236	... ...	2,729	38	... ...	... ...	... ...	575	... . .	... ...
Decrease	... ..	... ...	... ...	... ...	1,170	... ...	... ...	2,667	... ...	1,369	... ...	... ...	8

* Estimated. *b* Not published.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness).